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ABSTRACT

This booklet offers teachers a variety of ideas and resources to strengthen partnerships with parents. Challenges and reasons for involving families are discussed. Several methods of communication are presented such as written, face-to-face, and technological communications; various ways of doing activities and homework with their children are offered for parents. (Contains 16 references.) (ASK)

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Engaging Families in Mathematics and Science Education

It's Just Good Teaching

ED 425 935

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Engaging Families in Mathematics and Science Education

It's Just Good Teaching

by Jennifer Stepanek
Mathematics and Science Education Center

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Northwest Regional Educational Laboratory

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Preface

Engaging Families in Mathematics and Science Education offers teachers a variety of ideas and resources to strengthen partnerships with parents. Families and schools should be natural partners in children's lives. Both play a key role in successful learning: whether nurturing the tentative young child in kindergarten who is just beginning to explore the wonders of learning, guiding the confused adolescent in middle school who is testing the waters of independence, or supporting the confident young adult in high school who is preparing to embark on a new adventure into the world of work or postsecondary education. Unfortunately, effective school-family partnerships have too often been an elusive goal.

Mathematics and science often pose special challenges for family involvement. Many parents say, "I was never any good at math," or "I never liked science." This may make it difficult to encourage parents to do mathematics and science with their children. Teachers must communicate the importance of learning mathematics and science to both students and parents. Knowledge of these subject areas is essential for all students as they prepare for the future and make sense of their world.

Another aspect of the partnership with families is educating parents about the exciting changes underway to improve student learning in mathematics and science. Parents need to know how they can help with homework and activities that may be unfamiliar. Teachers must also address parents' valid questions and concerns about mathematics and science education reform.

This booklet continues the Northwest Regional Educational Laboratory's *It's Just Good Teaching* series on important issues in mathematics and science education. Other topics in the series include equity, strategies for inquiry teaching and learning, standards-based teaching, assessment to inform instruction, and technology in middle school mathematics. Each publication addresses a fundamental component of a high-quality mathematics and science education program that meets the needs of all students.

Families and schools working together—like any worthwhile partnership, it takes commitment, flexibility, and concerted effort. Yet the work pays off for both teachers and parents, and the benefits for our children extend beyond the classroom and home.

Kit Peixotto
Director
Mathematics and Science Education Center

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Introduction

Messages about the importance of family involvement are neither new nor uncommon. Educational research consistently shows that one of the most important and effective resources available to a child is his or her family. Unfortunately, many schools fail to nurture relationships with all families, and many parents are not actively involved in school. In addition, parents are even less likely to participate in mathematics and science than they are in other subject areas. Parents are universally and persistently encouraged to read with their children, but they are seldom encouraged to work with their children on mathematics and science activities.

In order to enjoy the benefits of family involvement, schools and teachers will need to approach all parents as collaborators in the education process. Creating a true partnership with parents is challenging and requires effort and commitment. Interactions among teachers, parents, and students will not always be simple and immediately effective. Nevertheless, when both schools and parents are committed to working together and approach each other with mutual respect and trust, questions and debates can be resolved and conflicts can be overcome.

This publication is designed to support educators as they identify ways to help all parents become more active in mathematics and science education. The first section outlines the research-based rationale for improving family involvement and summarizes the barriers that teachers and parents must often overcome in order to work together. The second section is devoted to strategies that many teachers and schools are using to involve parents in mathematics and science education. The final section points teachers toward additional resources to enhance their family involvement efforts.

Of the six types of family involvement, this publication focuses on communicating, volunteering, and learning at home because these activities are the most directly related to mathematics and science education. Nevertheless, the other three types of family involvement are equally as important: Schools cannot neglect any of these practices if they wish to establish a true partnership with parents.

Six types of family involvement

- Developing parenting skills—helping parents provide for the health, safety, and well-being of their children
- Communicating—providing parents with information about school programs, goals, and their child's progress
- Volunteering—recruiting and organizing parents to help provide time, resources, and support for the school and the students
- Learning at home—describing how parents can extend learning outside of class and help with homework and student planning
- Decisionmaking—including parents in the school decisionmaking processes
- Collaborating with community—helping link families with resources and services in the community

(Epstein, 1995)

It is also important to point out that, although the term family involvement is used throughout this publication, the activities and roles are not limited to mothers and fathers. Any adult involved in a child's life can take an active part in his or her education, whether it be an extended family member, neighbor, mentor, or other caregiver.

Why involve families?

Student achievement and motivation. The benefits of family involvement are well established. For more than three decades, researchers have consistently found that parent involvement improves student achievement, motivation, and attitudes about school.

Anne T. Henderson has published two comprehensive studies of family involvement. The first, *The Evidence Continues to Grow: Parent Involvement Improves Student Achievement* (1987) examines 49 studies. The second publication, *A New Generation of Evidence: The Family is Critical to Student Achievement* (1994) with co-author Nancy Berla, covers 66 studies, reviews, and reports. From her review of these studies, Henderson concludes that some of the major benefits of parental involvement are:

- higher grades and test scores
- long-term academic achievement
- positive attitudes and behavior
- more successful programs
- more effective schools (Henderson, 1987)

The evidence indicates that parents contribute to student achievement at all grade levels and that efforts to improve achievement are significantly more successful when parents actively participate (Henderson & Berla, 1994).

The research also shows that students benefit from many different types of family involvement. In her review of more than 40 family involvement studies, Sattes (1985) concludes that gains in student achievement are reported from a range of activities, such as keeping parents informed of their child's progress and encouraging parents to reinforce their child's school learning. Training parents to act as home tutors resulted in the highest achievement gains.

Researchers attribute the benefits for students to a variety of factors. When the attitudes and expectations of parents and school are in agreement, learning is extended beyond the classroom and into the home. Students receive a common message about the importance of thinking and learning, hard work, and perseverance (Epstein, 1995). When parents participate, they show their children that school activities are interesting and important. Students have an opportunity to observe and model their parents' positive attitudes and behaviors. With attention and praise, parents validate and encourage their children's efforts (Hoover-Dempsey & Sandler, 1995).

The results of the Third International Mathematics and Science Study (TIMSS) have added urgency to efforts to improve mathematics and science education. TIMSS is the most comprehensive international comparison of student achievement, with more than 40 countries participating. Although fourth-grade students scored above the international average in mathematics and science, the scores of eighth- and 12th-grade students fall progressively below average.

As schools attempt to address the TIMSS results, educators may want to consider making parents a part of their efforts to improve mathematics and science education. For example, some researchers believe that parents contribute to the high achievement of Japanese students. In Japan, it is common for mothers to work with their children at home to enhance their classroom mathematics instruction (Reys & Reys, 1995).

In response to the TIMSS results, the U.S. Department of Education and the National Science Foundation formed an interagency working group to develop an action plan for improving student achievement. One of the three priorities for action is providing parents with information and activities to reinforce classroom learning and to emphasize the importance of achievement in mathematics and science (U.S. Department of Education & National Science Foundation, 1998).

Improving student motivation is often just as significant as increasing achievement. For example, it is important for students to see the relevance and application of mathematics and science outside the classroom. Parents are instrumental in demonstrating the many uses of mathematics and science in home life, jobs, and other real-life situations (Ford, Follmer, & Litz, 1998). When students are aware of mathematics and science outside the classroom, they are more motivated and can develop a better understanding of what they are learning.

Students need encouragement from their parents to take mathematics and science courses and to set high educational goals. In her study of high school students' attitudes toward science, Victoria B. Costa (1995) found that ability was not the deciding factor in students' choices to participate in science. Students were more likely to be interested in science and to pursue higher-level courses and science-related careers if they recognized connections between the worlds of home and school. Parents provide essential support and an additional "pathway into the world of science" (Costa, 1995).

Benefits for teachers and schools. In addition to direct benefits for students, research has linked family involvement to a number of other positive outcomes for schools. For example, parents who are actively involved are more likely to support school funding efforts. Parents also provide a variety of perspectives, enabling educators to better meet the needs of the people they serve. When they interact and work with parents, school personnel gain insight into the community and a better understanding of students and families (Comer & Haynes, 1991).

Parents who take part in the school and their children's education are more likely to have positive attitudes toward teachers and provide them with more support. When parents participate, they have a better understanding of the challenges that teachers face and have more appreciation for their efforts and professional skills (Fruchter, Galletta, & White, 1992). The morale boost that teachers receive from supportive parents helps them to feel more positive about their jobs and their schools (Leitch & Tangri, 1988).

Support for educational reform. Parents are more knowledgeable about educational issues and have a better understanding of reform efforts when they have firsthand experience of what happens in the schools. This outcome is particularly relevant for mathematics and science education, because the practices called for in the reform documents are significantly different from the teach-

ing and learning that most parents experienced when they were in school.

Although a few parent representatives were included in the design of the *Curriculum and Evaluation Standards for School Mathematics* (1989) from the National Council of Teachers of Mathematics, and the *National Science Education Standards* (1996) from the National Research Council, many parents are not aware of these documents. When parents are informed of changes under way, they often do not receive information about the rationale or evidence of effectiveness (Peressini, 1996).

Misconceptions and concerns about reform create public opposition to standards-based teaching methods and innovative projects, especially in the area of mathematics. In some schools, parents and other community members are attempting to reverse or prevent changes, forcing teachers to adopt more traditional approaches and materials (Dillon, 1993; Peressini, 1997).

Often, articles in newspapers and magazines perpetuate misconceptions about what some call "fuzzy math," "whole math," and "new New Math." One example is a recent article in *Time* magazine, that portrayed students who spend hours fruitlessly puzzling over problems with no guidance from their teachers and who are unable to do simple addition and subtraction without the help of a calculator (Ratnesar, 1997). These examples perpetuate misunderstandings of mathematics reform but do not reflect the teaching and learning experiences advocated by the standards documents. In the standards, the focus is on depth of understanding, problem solving, and conceptual development. (For an overview of mathematics and science reform, see Appendices A and B.)

Parent concerns

Research has identified some of the following misconceptions and concerns that parents have about changes in content and pedagogy:

Students are not learning the "basics." Teaching is no longer focused only on basic facts, vocabulary terms, and procedures. Students learn these concepts and skills in the context of complex problems and hands-on activities. Teachers use fewer worksheets and supplement textbooks with other resources. Parents may wonder why their children do not have much homework, and they may conclude that students are not learning "the basics" at all.

Classroom activities have no structure. Students sometimes pursue their own interests and questions. They often work on problems that have more than one right answer or more than one way of finding an answer. Students may come up with their own procedures and strategies. It may seem as if classroom activities have no design or purpose.

Students are being taught methods that are too drawn out and inefficient. The goal of mathematics and science teaching is for students to understand the concepts that they are learning, rather than memorizing a formula or a vocabulary term and using it repeatedly without understanding what it means. Teachers may allow students to try a variety of methods and strategies, instead of dictating the "right" way to proceed. Because this usually takes longer than giving students a formula, parents may see the process as too long and drawn out, believing teachers should teach the quickest, easiest way to find answers and complete tasks.

Teachers are not in control of the class. Students have more responsibility for and control over their own learning. There is much more interaction and discussion in the classroom. Students often work on complex tasks with minimal direct assistance from the teacher. Because the teacher's role is no longer to lecture in front of the class, it may appear that the students have "taken over" and that the teacher does not have control of the class.

(Peressini, 1997)

For the time being, there is less opposition to changes in science education. The American Association for the Advancement of Science (AAAS) recently studied parent attitudes about science education reform. In focus group interviews at various communities across the United States, parents revealed that they were less concerned about changes in science. Unlike mathematics, they had few opinions about what specific skills were basic to science. However, the parents said that they were often hesitant to support nontraditional methods of science teaching because such methods are unfamiliar. Parents feared that the changes would have an adverse effect on students' achievement and attitudes (American Association for the Advancement of Science [AAAS], 1996).

Communication and collaboration with parents are essential to addressing parents' concerns. The National Center for Research in Mathematical Sciences Education (NCRMSE) has examined the complex role of parents in its School Level Study of Mathematics Reform. The research from this study indicates that the more parents participate, the better they understand the changes that are occurring, and the more they support the schools and teachers (Peressini, 1997). If the reform of mathematics and science is to succeed, parents must become partners and advocates in the reform process.

Challenges in family involvement

In spite of the potential benefits parents bring to education, many schools continue to struggle with family involvement. Joyce Epstein, co-director of the Center on Families, Communities, Schools, and Children's Learning and author of many works on family involvement, has found that almost all parents want to be involved, regardless of their backgrounds or socioeconomic status. She concludes that "the evidence suggests that school policies and teacher practices are more important than race, parent education, family size, marital status, and even grade level in determining whether parents continue to be part of their children's education" (1990).

Teachers and parents often face significant obstacles when they try to work together. Some parents are comfortable with the culture of the school and are aware of the part they play in their children's education. But there are many other parents who feel excluded from the school community or are reluctant to assert themselves. Teachers and schools must address the needs of all parents if their efforts are to succeed.

Challenges for parents. Research has identified many reasons parents do not participate in their children's education.

In study after study, parents indicate that they want to help their children, but do not know how to become involved or how to help. Parents may not be aware of their important role in education if their own parents did not participate and they do not know other parents who are involved. They may not know how to approach the schools about becoming more involved and may not be aware of opportunities (Aronson, 1996).

Parents frequently complain that schools are unresponsive, that teachers talk down to them or use unfamiliar educational jargon. Communication tends to be infrequent and one-sided,

from school to home. In some schools, teachers only contact parents when there is a problem and parents receive little classroom-related information (Ames, Khoju, & Watkins, 1993).

For some parents, their past experiences with school make it difficult to become involved. They may have negative attitudes toward schools and teachers. Parents with limited formal education are often hesitant to help their children with schoolwork (Funkhouser, Gonzales, & Moles, 1997). Some parents are intimidated in school settings, fearing that they will appear foolish or be misunderstood (Finders & Lewis, 1994).

In more and more families, both parents work outside the home, and single-parent families are also increasingly common. This leaves less time for parents to connect with teachers. Parents are more likely to be unavailable at times when school conferences or activities are traditionally scheduled (Espinoza, 1988).

Language and cultural barriers contribute to parents' lack of involvement. Parents who don't speak fluent English or lack written literacy skills may feel inadequate or excluded (Aronson, 1996). Cultural mismatches also occur. For example, when children are asked to translate for their parents it goes against a cultural norm for many Hispanic families (Finders & Lewis, 1994). Asian immigrant parents may avoid interacting with teachers because doing so indicates lack of confidence and disrespect (Yao, 1988).

Challenges for teachers. Research has identified difficulties that teachers face in trying to involve parents.

It is impossible to use a single form of communication to reach all parents. If parents do not respond to typical outreach efforts, teachers may assume that they are apathetic or unwilling to take the time (Swap, 1993). Parents often do not see letters and flyers, which students lose on the way home or forget at school.

Even well-meaning teachers may feel that parents are not able to help their children with schoolwork. Teachers often worry that parents will undermine classroom instruction or disrupt the learning environment (Henderson, 1988). Collaboration with peers is relatively unusual in the culture of most schools. Working closely with parents may feel uncomfortable for teachers who are accustomed to being autonomous in their classrooms (Lieberman & Miller, 1992).

Teachers may feel they do not have enough time to work with parents. The demands on teachers have increased, often without comparable increases in support and resources. Teachers may approach family involvement as a luxury that they cannot afford to spend time developing, rather than as an investment.

Most teachers have not been trained to work with parents. According to a study by the Harvard Family Research Project, most states do not require training in family involvement for certification, and most teacher education programs do not offer concrete training in family involvement (Shartrand, Weiss, Kreider, & Lopez, 1997).

Middle school and high school. Teachers face added challenges in encouraging family involvement in middle school and high school. Parents tend to be less involved as their children grow older (Myers & Monson, 1992). In the past, schools usually made little effort to involve parents after their children left elementary school. But many educators now realize the importance of maintaining family involvement through high school and are increasing their efforts to keep parents active at school. Improving family involvement at the middle school and high school level will require attention to some unique issues.

A number of factors contribute to a less personal relationship between parents and teachers. The school is likely to be farther away from the family's home (Rutherford & Billig, 1995). Teachers at this level typically work with more students and their role does not emphasize contact with parents (Dornbusch & Ritter, 1988). Parents may need to contact as many as seven teachers to keep a complete picture of their child's progress (Foster-Harrison & Peel, 1995).

Parents and teachers often believe that students should be more autonomous and that students do not want their parents involved in the school. However, while studies indicate that students at this level do want greater autonomy, they also want and need their parents' support (Eccles & Harold, 1993). Family

involvement activities used in elementary school may no longer be appropriate, but parental support and participation is just as important.

As the subject matter that their children study becomes more advanced and technical, parents may feel even less confident about their skills and knowledge. Many parents assume that they should not attempt to help their children with homework if they do not have expertise in the subject matter (Rutherford & Billig, 1995).

Students need guidance and encouragement as they deal with the changes of adolescence and as they plan for the future. By actively participating in school activities and supporting learning, parents encourage their children's interest and persistence in school.

Mathematics and science. In mathematics and science learning, many of the barriers to family involvement are more pervasive and more difficult to address.

Because of past educational policies and teaching practices, parents are more likely to be unfamiliar and uncomfortable with the subject matter in mathematics and science. Research has shown that even well-educated parents may have limited proficiency or literacy in science, and may even be fearful of science and mathematics (Project 2061, 1997). This leads many parents to assume that they will not be able to help their children. Hoover-Dempsey and Sandler (1997) found that parents based their decisions about how to participate in their children's education on their perceptions of their own abilities. If parents do not feel knowledgeable about mathematics and science, they are less likely to participate in mathematics and science homework, activities, and discussions with their children (Hoover-Dempsey & Sandler, 1997).

Parents often think of mathematics and science as school subjects that are unconnected with their daily lives. Thus, they miss teachable moments and opportunities to engage their children in thinking and asking mathematical or scientific questions as they go about day-to-day activities (Ensign, 1998).

When parents express dislike for or fear of science and mathematics, it can lower children's expectations of their own ability in these subject areas. This is especially true of girls, who are more influenced by parent attitudes than boys (Kober, 1992). Unfortunately, it is acceptable and even common for people to say, "I have never been good at math," although few would ever admit, "I'm just not good at reading." Parents may not realize that they influence their children's attitudes when they confess their lack of mathematics or science skills.

Due to their own educational experiences, parents may have low expectations for their children in mathematics and science. It is common for Americans to believe that these subject areas require innate ability rather than effort in order to achieve mastery (Kysilko & Earle, 1992). Parents are likely to sympathize and accept their child's poor performance in mathematics or science.

Frequently, parents are not aware of the importance of studying mathematics and science. They may not know what courses their children need to take in order to pursue educational and career goals. Parents may not expect their children to pursue mathematics or science-related careers, and they may not understand that students need mathematics and science knowledge for all jobs, not just science and technology fields.

Increasing family involvement

There are two essential components of effective family involvement: First, teachers and schools reach out to parents and make them a part of the school community. Second, parents feel that the school respects and values their efforts and activities, no matter how small (Mapp, 1997). Just as schools need to set high standards for student achievement, they also need to set high standards for parents. If schools hold low expectations for parent participation, few parents are likely to take advantage of opportunities to become a part of their children's education.

When developing plans to bring parents into the school community as partners, it is important to know why some par-

Reaching out to all parents

As student populations become more diverse, it becomes increasingly important for schools to address the gap between home and school cultures. When schools do not make efforts to involve all parents, the education level and social class of parents determine whether or not they participate. These factors become much less significant when schools shape their practices to meet the needs and build on the values and strengths of all families (Fruchter, Galletta, & White, 1992).

In order to reduce the barriers of race and class, schools and teachers will need to take a positive and inclusive approach to parent involvement. This means assuming that all parents want to and are able to help their children succeed. It is also important for schools to respect the strengths that each family brings to a child's education.

When there are differences between home and school cultures, expecting families to change and fit into the school's culture is not effective. Successful family involvement programs help all parents become active participants in shaping their children's development and school experience.

The following strategies will help to make the school culture more inclusive and inviting for all children and their families (Swap, 1993):

- Parents and teachers work together to bring families' language, culture, and ethnicity into the school in positive ways
- Parents are used as resources in developing curriculum that accurately represents the histories, viewpoints, and achievements of all cultures
- Parents provide expertise in culturally sensitive teaching and learning and help develop instructional strategies that address the needs of all children
- Parents help teachers learn how to confront racism and discrimination and to examine their subconscious beliefs about the characteristics of successful students

ents do participate. Researchers have identified three primary reasons that parents become involved in their children's education (Hoover-Dempsey & Sandler, 1997):

1. Parents perceive active involvement in learning activities at home and at school as part of their role as parents

2. They believe that they are able to help their child by becoming involved, and that their actions make a difference

3. Parents receive and are aware of many invitations to come to school or to work with their child at home

This information can help teachers develop strategies for working with parents. Schools will need to make sure that parents understand their important role in teaching children. Teachers will need to make sure that parents know exactly how to help their child and how to participate. Parents must realize that their actions have a positive influence. Schools will need to give parents many invitations to become involved and extend these invitations in a variety of ways.

It is essential that schools make every effort to reach all parents—not just those who are easily available—and to accommodate the realities of family life. There is no one activity or form of communication that will work for all. The success of strategies depends on how well they fit the needs and interests of families and the situations of teachers and schools (Swick, 1992). Schools strengthen their efforts when they offer parents a variety of roles to take in education. For example, some parents may not be able to come to school, but are willing and even eager to work with their child at home.

Parents themselves provide the best information about how to work with parents. Schools should consider conducting needs assessments to determine how parents would like to participate, when they are available, and how best to communicate with them. Recruiting parents to help develop and improve family involvement strategies is essential. Parent volunteers can also help make contact with parents who are not yet active (Comer & Haynes, 1991).

Because of the emotional appeal, many schools find that the most effective invitations to parents come from the students themselves (Tracy, 1995). Students should be aware of the various opportunities for their parents to participate in their education, both at school and at home. Students often need suggestions on how to talk to their parents about schoolwork, academic decisions, and homework (Epstein, 1995).

Communication

The cornerstone of effective family involvement is frequent, open, and two-way communication. It is necessary for the success of all other family involvement efforts. Sometimes, merely informing parents of the benefits they can provide for students is enough to increase their participation. However, parents frequently want more guidance in how to become involved.

Both schools and parents need to learn how to communicate effectively with each other. Some schools send out large quantities of information—letters, notes, progress reports, newsletters—and assume that their communication system is complete. However, teachers and schools are also responsible for ensuring that parents are receiving the information, that it is helpful, and that it is in a form that parents are able to use and understand.

Furthermore, parents need opportunities to communicate their needs and concerns. Schools and teachers can be more responsive when they know about parents' feelings and expectations about education. Because they know their children so well, parents can provide teachers with many helpful ideas of how to improve achievement or motivation.

As schools strive to develop partnerships with all parents, they will need to develop strategies to eliminate language barriers. One of the most important strategies is translating all written materials for non-English speakers. Whenever possible, schools will also want to provide a resource person—school staff person, community volunteer, older student—to translate for teachers and parents.

Written communication. There are a number of ways that teachers can provide parents with information about mathematics and science. For example, many schools distribute a parent handbook with school calendars, a list of school staff, and volunteer needs (Schurr, 1992). The handbook can also be a useful tool for helping parents become more familiar with mathematics and science. Some helpful topics include the importance of mathematics and science literacy for everyone, finding mathematics and science in everyday activities, and strategies to encourage children's interests.

Parents are much more likely to participate in school if they have personal contact with the teacher (or teachers). Teachers may want to call or write to parents at the beginning of the school year to

Family Involvement in Mathematics and Science Institute

In June 1997, the Science and Mathematics Consortium for Northwest Schools conducted the first Family Involvement Institute at Boise State University in Idaho. The institute was designed to provide teachers with tools to increase parents' participation in mathematics and science education. School teams from Alaska, Idaho, Montana, Oregon, and Washington attended the four-day institute to learn strategies and develop ideas for creating successful programs in their classrooms and communities.

Consortium staff members Barbara Eisenbarth, Idaho State Coordinator and Equity Specialist, and Joy Wallace, Program Specialist, developed and facilitated the institute. They both saw a great need for professional development in family involvement. Wallace points out that very few teachers receive preparation for family involvement and often have difficulty working with parents. "All schools want support from parents and want them to serve as volunteers, field trip chaperones, and fund-raisers. However, many administrators and teachers are not comfortable discussing curriculum or pedagogy with parents."

At the Family Involvement Institute, teachers discussed the benefits and challenges of family involvement. The teams learned strategies to help parents experience and understand mathematics and science teaching. The main focus of the institute was on Family Math and Family Science programs. The teams participated in hands-on activities, experiencing them as parents would. Anne Baldrica, a teacher from McCall-Donnelly Elementary in McCall, Idaho, found that participating in the activities was helpful. "I got to experience the excitement of trying new things from a parent's perspective, as well as the challenge of figuring things out."

Wallace and Eisenbarth provided tips on how to organize Family Math and Family Science programs. The teams learned how to reach out to parents, for example, by holding events at community locations rather than the school.

Many of the participants mentioned team-building and collaboration as a highlight of the institute. Ellen McKin-

ney, also a teacher at McCall-Donnelly Elementary, especially enjoyed the contact with teachers from other states. "We definitely gained from the trials and errors of each other's experiences. The institute gave us a chance to share our strengths with each other."

During the institute, participants kept journals to reflect on their experiences and what they were learning. As a final project, each team submitted an action plan to conduct a series of four to six family involvement sessions during the next school year. The teachers used the strategies they learned and adapted the approaches to fit the needs of their schools' students and parents.

At McCall-Donnelly Elementary in McCall, Idaho, the family involvement team conducted a Family Math session this spring. After talking with parents at her school, Pam Erikson, a teacher at Dorothy Fox Elementary in Camas, Washington, decided to incorporate Family Math activities into the regular school day. The parents came to school once a week to work on activities with their children.

Dan Brown, a teacher from Warm Springs Elementary School in Oregon, put together a school team in the fall and coordinated two Family Math nights and one Family Science night. The math events were arranged around the various grade levels. Families started the evenings by visiting stations with easy, self-explanatory activities. The whole group would then work on a longer, more complex activity. The Family Science night was an event for the whole school with many activity stations: an Ooblick table, bubble making, and tower building with toothpicks and marshmallows, to name a few.

Anyone interested in finding out more about the Family Involvement Institute can contact Joy Wallace at (503) 252-4999 or joy@col-ed.org.

establish an open and friendly relationship. This is an excellent time to outline goals for the year and describe the curriculum and assessment methods (Fowler & Corley, 1996). Teachers may want to give parents information about homework—how often it will be assigned and how they can help their children. Teachers can also extend an invitation for parents to make classroom visits and volunteer at school.

It will be helpful to send follow-up notes throughout the year. Some teachers send letters home to inform parents about the mathematics and science topics the students are studying. They also include suggestions of relevant activities or discussion topics that parents can use at home. It is also important to provide a means for parents to respond. Teachers can ask questions and solicit information, providing a form that parents can return. Encouraging parents to send their own notes or to call the teacher when they have information to share or questions to ask is another way to improve the flow of communication.

Teachers might want to develop a class or department newsletter, perhaps highlighting mathematics and science. Parent volunteers can help with the design and printing. This is an excellent way to keep parents up-to-date about what is happening in class. A section dedicated to mathematics and science can also be worked into a schoolwide newsletter. For example, teachers might highlight a district or state standard or goal in each issue. Descriptions of activities, examples of student work, and criteria for assessment help parents understand the curriculum and teaching methods.

Teachers can also use the school newsletter to provide parents with mathematics or science activities to do at home (Klosterman, 1998). The problems can be adapted from the work that children are doing in class, or there are several books with family activities listed in the resources section at the end of this document. Using the names of school staff and local streets and landmarks will help personalize the problems and generate interest. The solutions can be provided in the following issue, with an outline of a possible process used to solve the problem, so that families are able to compare their own answers and strategies.

All written materials should be clear and concise, jargon free, and translated into languages that parents speak and read. Schools may want to provide parents with a list of educational terms and definitions in case jargon slips through or to make sense of information they receive from other sources.

Face-to-face communication.

Informal meetings and telephone calls can be most helpful in building trust and give parents opportunities to ask questions about school issues and activities (D'Angelo & Adler, 1991). Contact between teachers and parents that is frequent and personal is more visible to the child and therefore has greater potential to make an impact (Ziegler, 1987). By establishing a good relationship with parents, individual teachers have the most influence on the quality of family involvement. As they interact with parents, teachers model respect and openness, respond to parent concerns constructively, and demonstrate sensitivity to family needs (Swick, 1992).

Personal contact with parents is usually more difficult to maintain as students grow older. At the middle and high school levels, some schools have found it effective to assign a teacher to each student to serve

as an advisor and to keep in touch with parents (Eccles & Harold, 1993).

In order to maintain communication with parents, teachers should be provided with time to make and return telephone calls. For example, a teacher might want to plan to call a certain number of parents each week or each month, just to touch base. Time can also be set aside in which teachers will be available to take calls. All parents should know when they can speak directly to a teacher if they have questions or concerns.

Parent-teacher conferences should be opportunities for teachers to gather information as well as to report student progress. More parents will be able to attend if conferences are scheduled at a variety of times and held at convenient locations, possibly other than the school. Conferences will be more productive if teachers encourage parents to come with questions and concerns. Parents, teachers, and students can use the time to set goals and develop action plans. When there are problems to be addressed, parents will be able to respond more constructively if teachers elicit help rather than placing blame on parents or students.

Technology. Technology can be a useful tool to help parents stay in contact with teachers. Ideally, every teacher should have easy access to a telephone. Unfortunately, not all teachers do, and this relatively simple tool is often left out of current discussions about technology in schools.

Voice-mail systems can help ensure that teachers receive messages and also allow parents to leave messages at convenient times—parents may not be able to call during regular school hours. Hotlines with taped messages describing school events, classroom activities, or homework assignments can also provide parents with frequent and up-to-date information.

Parents who cannot come to school will appreciate being able to borrow videotapes of classroom activities or school events (Swap, 1993). School or district Web sites and e-mail addresses for all teachers can also be an effective means of communication. However, schools should not use the Internet as the primary method because many parents do not have access to computers at home or at work.

School and classroom activities

Bringing parents into the school as volunteers and observers is one of the most important forms of family involvement. Teachers benefit from the added support. When children see

their parents at school, it validates the importance of learning and increases continuity between home and school. Other students, especially those whose parents do not participate at school, also get a boost from seeing community role models involved in school activities (Comer & Haynes, 1991). When they participate at school, parents have an opportunity to see their children's learning and growth firsthand. They often develop a greater appreciation of the challenges that teachers face (Swap, 1990).

Unless school personnel make explicit invitations, parents may not realize that they are welcome in the classroom. Teachers can help by frequently encouraging parents to come to school and making suggestions about how they can help. Even a short visit to the classroom can make a difference, and parents who start out as observers may become increasingly involved over time.

Parent volunteers carry out a variety of duties in the classroom. During hands-on experiments, extra help from parents can be invaluable. They can help monitor students working in groups, obtain resources for activities, and organize set up and clean up. Teachers may want to provide an informal orientation, with an overview of instructional methods and a sample activity (Pearlman & Pericak-Spector, 1992).

Parents can also contribute by working one-on-one with students, both during and after school. Parent tutors can provide students with individual instruction and encouragement. Some middle schools and high schools have created study centers staffed by parent volunteers (Graf & Henderson, 1997). The centers can be housed in empty classrooms or an area of the school library. Community centers, public libraries, churches, or shopping centers are other possible locations.

Many parents enjoy serving as guest speakers in their children's classrooms. There are a variety of activities appropriate for any grade level. Parents with scientific or technology careers can make presentations about their jobs. Parents in other fields can share how they use mathematics or science skills in the workplace or at home. Parents can also collaborate with teachers to develop and present a lesson or activity based on their jobs or hobbies such as astronomy or geology.

Parent mentors establish sustained, personal relationships with students, providing guidance and support. Mentors are often paired with students based on educational or career interests. They may also serve as role models, helping students to develop more general life skills. The power of this relationship emerges from the fact that students identify with their mentors. In students' eyes, mentors often have more credibility than teachers and give added force to messages about the importance of education.

Home activities

Home learning activities are an important part of family involvement and are the most effective for improving student performance. Schools may not put as much effort into guiding this form of involvement. Home activities have traditionally been considered the most difficult for schools to facilitate, but they may be the most useful and relevant to parents, because time constraints or other factors often prevent

parents from coming to the school (Epstein, 1991).

There are a variety of activities teachers might initiate to help parents extend learning at home, such as providing parents with information about the curriculum and instructional practices. Teachers encourage parents to work with their children by letting them know how they can help and that their help is valuable, no matter their level of education or expertise with mathematics and science.

Interactions. Studies show that parents may affect the outcome of learning activities according to how they interact with their children during the activities. Parents promote factual knowledge when they use close-ended instruction, such as giving commands, requiring correct answers, and solving problems "the right way." However, when parents use open-ended instruction—asking questions and encouraging students to anticipate and explain answers—students tend to demonstrate higher-level thinking in addition to factual knowledge (Hoover-Dempsey & Sandler, 1995).

The first model is more likely to fit into parents' past experiences of teaching and learning. Therefore, parents may find ideas and encouragement useful in order to move toward the second model. Teachers can give parents helpful suggestions for interacting with their children, such as questioning techniques to encourage learning. (The sidebar above provides some tips to share with parents.) Parents can also help by conveying high expectations, showing interest in what their child is learning, being aware of the activities at school, and discussing the value of a good education (Henderson, 1988).

Everyday mathematics and science. One of the goals of mathematics and science teaching is for students to appreciate how the concepts and skills are used in the real world. With some guidance from teachers, parents can play an important role in achieving this goal. Most parents will need ideas of how to talk about and emphasize mathemat-

Questioning techniques for parents

- When your child asks a question, respond by saying, "That's a good question. What do you think?" or "How can we find out?"
- Show interest in and listen to you child's questions and activities.
- Discuss activities before, during, and after doing them. Encourage your child to explain what she is doing and why as she goes along.
- When you ask a question, give your child plenty of time to respond. Ask open-ended questions rather than yes-or-no questions only.
- Encourage your child to make predictions, make comparisons, and draw conclusions.
- Share your curiosity with your child. Let him see you ask questions, make observations, and draw conclusions.
- Don't pretend that you know the answer and don't feel badly about not knowing. Show your chil how to go about finding an answer.
- Ask your child questions about her answers whether they are correct or not. Ask her, "What made you think that?" or "How did you get that answer?" before you tell her an answer is right or wrong.

(Pearlman & Pericak-Spector, 19
Great Explorations in Math and Science, 19

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Homework tips for parents

Homework is an important part of your child's education. It supplements and reinforces classroom learning. It also helps students establish study habits, self-discipline, and responsibility.

- Establish a routine schedule for homework and a quiet area for study.
- Offer praise and encouragement.
- Your role is a "coach," your child is the "thinker and doer." Encourage her to work as independently as possible.
- When your child begins an assignment, ask him to explain it in his own words. Go over the expectations for his work. If appropriate, discuss possible sources of information and help your child obtain resources.
- When your child has difficulty getting started, do several problems together and then observe as she works through the next few on her own.
- If your child asks for help, ask him to explain what he does not understand. Work together on an example instead of simply giving him the answer.
- Wrong answers are opportunities for learning. Discuss the problem and the strategies used to solve it. Going back over the steps may reveal a misunderstanding or a wrong turn.
- If there is still confusion, help your child identify what she needs to find out and to plan her next steps.
- When the assignment is complete, discuss whether your child's work answers the original question and meets the teacher's expectations.

(Berkowitz, 1996; Paula, 1995)

ics and science in everyday activities. Furthermore, parents may not think about the fact that they are using mathematics and science when they cook, pay bills, prepare budgets, shop, read maps, fix appliances, or keep score during sports events. Teachers can encourage parents to include their children in these activities and to make sure that children know that they are doing mathematics and science.

Some parents will be reassured if they know that they can help their children develop science skills without conducting complicated activities or turning their homes into laboratories. Activities such as observing, noticing change, recognizing patterns, estimating, measuring, and sharing information can fit easily into everyday family life.

Discussing mathematics and science in the popular media will often encourage family participation. Newspaper and magazine articles are excellent starting points for discussions (Morvitto & Brooks, 1995). For example, a teacher might ask students and their family members to analyze a story about the latest medical news: Are there important questions that are not addressed in the article? Are the findings conclusive and sound? What are the characteristics of "good science?" Teachers who have access to videotapes of science programs might send tapes home with discussion questions as an enrichment activity for individual students.

Another way to help students and their parents develop awareness of "real-life" applications is through interviews. This type of activity can be appropriate for any grade level. Students might ask a parent or another adult about how they use mathematics or science in their job and then design a few problems that

demonstrate these uses (Barnes, 1993). Students can also work with their families to identify how they use a concept from classroom learning.

Decisionmaking. Parents provide a great deal of encouragement when they help their children set goals, make decisions about what classes to take, and think about the future and possible careers. Every parent will need to be aware of all options that are available to their child and understand the implications of their choices (Eccles & Harold, 1993). The guidance that schools and teachers provide is essential because parents may not realize the importance of mathematics and science to their child's future. Parents need to know what classes are necessary in order to take higher-level courses, to get into college, and to prepare for careers.

Homework. Many parents are concerned about helping children with homework because they do not want to interfere or do not feel confident about their own knowledge and skills. Providing guidelines and advice is essential if parents are to support students' classroom learning. (The sidebar on the opposite page provides some tips that parents may find helpful.) Teachers encourage parents to participate when they inform parents about the expectations for student work and explain that all parents can and should help, no matter how well they know the subject matter.

Teachers might also want to design special homework assignments that require parents' participation. *Teachers Involve Parents in Schoolwork* (TIPS), developed by Joyce Epstein, can be a useful guide in creating these activities. Teachers use the assignments once a week or every other week to keep families informed and involved. A science activity, for example, may require students to conduct and discuss a hands-on lab or data collection activity related to their classwork. The assignments usually fit on one sheet of paper and include the following components: a brief description of the topic and skills involved, the objectives of the activity, step-by-step instructions and questions, and a section for parents to evaluate the activity and write comments. Follow-up sessions in class reinforce the importance of homework and the importance of family involvement (Epstein & Salinas, 1992).

Activities. Teachers may also want to provide special activities that families can do at home. These activities might be formal assignments, tied directly to classroom learning. On the other hand, a more casual approach—providing general activities that families can do whenever they have time—can also be effective. Parents and students are more likely to have time for the activities on weekends or during vacations.

Activities will have the most impact if they are fun to do and are more engaging than the assignments parents remember from their own school days— worksheets or computation drills. Teachers usually get the best response from activities in which families play games, conduct investigations, collect data, and make predictions (Ehnebuske, 1998).

Because these types of activities are often unfamiliar, parents will appreciate thorough guidelines on how to facilitate home assignments. Any or all of the following details will be helpful: simple but complete directions, ideas of what might happen during the activity, the expected outcomes, and suggestions of what to do if the activity does not go as planned or does not produce the expected results. It is also important to let parents know the

objective of the activity, how it fits into the curriculum, and its connection to classroom learning.

Home activities also provide an opportunity for students to become teachers and leaders. Teachers might ask students to practice teaching a lesson to each other. Students then take the materials home and teach the activity to their parents or other family members. The following day, students conclude the assignment by discussing how their lessons turned out and the strategies their families used to solve the problem (Hart, Smyth, Vetter, & Hart, 1996).

In order to plan new activities, teachers may find it useful to ask parents for feedback with an evaluation form. Parents will be able to let teachers know how the activity went, whether or not the family enjoyed it, and ideas for further activities. Some teachers use a parent-teacher journal or diary that is sent back and forth between home and school throughout the year (Ehnebuske, 1998). Teachers use the journal to give specific suggestions for parents and to respond to their observations and questions. Parents' observations are often fresh and insightful and can be very informative for teachers.

Teachers can encourage family participation at home by providing science kits that are ready to go with instructions and materials (Ashford, 1995). Students check out the kits they are interested in and take them home to use with their families. Possible kit topics include magnets, static electricity, gravity, liquid density, and properties of light. Mathematics kits might include activities using manipulatives or games that require problem solving and mathematical reasoning (Leonard & Tracy, 1993). The kits should feature activities that make learning mathematics and science fun and nonthreatening for both parents and students.

Parents will need to know how the kits enrich classroom learning. Teachers can use the instructions to encourage parents to allow children to identify their own questions and suggest investigations, rather than following the directions explicitly. Parents can also help out by donating or gathering materials for the kits.

Providing one- or two-page activity sheets that do not require materials or use only common household items can also encourage family participation (Rillero, 1995). For example, a teacher might provide parents with a list of card games and board games and explain what mathematical skills are developed and how the games are tied to classroom learning (Leonard & Tracy, 1993). During an astronomy unit, parents can take part by making observations with their children and recording findings on a data sheet. Parents may find it helpful to have a sample record, a few ideas of things to look for, and a list of questions to use with their child (Brandou, 1997).

Pamela Erickson, who teaches at Dorothy Fox Elementary in Camas, Washington, regularly provides home activities for parents to try with their children. Rather than just sending the assignments home, she also asks parents if they were able to do the activities and how much their families enjoyed them. In talking to parents, Erickson has found that many of them have been turned off by school activities and especially mathematics. However, they do enjoy the fun, hands-on activities that she sends home. "Most of the parents are not afraid of the activities, but instead find that they are easy to use at home. That is the most reward-

ing part for me, to be able to help parents overcome their fear of math."

Community resources. Parents may not be aware of the many community sites they can visit that are related to mathematics and science. Teachers can encourage families to explore by providing lists of resources such as museums, gardens and nurseries, observatories, parks, farms and dairies, recycling centers, and weather stations. Some ideas of what to look for at the sites and the connections to classroom learning will also be helpful for parents. Other suggestions, such as letting the child take the lead, sharing curiosity and enthusiasm, and listening to the child's explanations and questions will help parents to enrich their children's learning during family visits. Teachers and parent volunteers might want to organize weekend outings for groups of families.

Special events

Mathematics and science events are an effective way to involve families and show them that mathematics and science can be interesting and fun. Informal events provide a place for families to do mathematics and science in a relaxed and social atmosphere, and may give parents the support they need to begin doing activities at home. In addition, events that take place on evenings or weekends are usually the most convenient for working parents.

Classes and meetings. Meetings about mathematics and science enable teachers to generate interest and address parents' concerns. Schools can either plan special meetings or dedicate time to mathematics or science during events such as orientations, PTA meetings, or parent nights. During the meeting, teachers can review the curriculum, assessment methods, and any relevant benchmarks or standards. It will also be helpful for parents to learn about unfamiliar teaching methods. Conducting a typical classroom activity that allows parents to experience these methods firsthand is an effective way to address their questions.

At all meetings, parents need opportunities to express their concerns and to ask questions. If they are simply presented with information, it will be difficult for parents to come to their own understanding of educational issues, standards, and reform. One way to accomplish this is to ask parents to talk about their past school experiences, both good and bad. The parents reflect on what children should learn

and what skills they will need to be successful. Teachers then demonstrate how they are providing the content and experiences that parents value (Daniels, 1996).

Another approach to engaging parents and increasing their confidence is to offer classes for parents in mathematics and science. For example, an evening or weekend algebra class provides an opportunity to share strategies for student success (Perlstein, 1996). Parents become familiar with the curriculum and the teacher's expectations for students. Working together on a few problems will help parents gain confidence in helping with homework. Parents may find it especially helpful to have tips on how to help if their children become frustrated or have difficulty. Other possible topics for classes include problem-solving steps, how children learn, motivation, or how to facilitate home learning activities.

Classes in which parents and teachers learn together encourage partnership and help develop trust. For example, participants might learn about questioning techniques to promote student inquiry and depth of understanding. F.L. Holmes, a doctoral candidate at Oregon State University, conducted a series of Saturday classes for children, parents, and teachers to learn science together (Holmes, 1998). The children chose activities from a group of more than 40 prepackaged kits, working at their own pace with a parent or teacher. The goal was for all participants to be actively involved, discussing and working together. The teachers who attended the workshops became more excited about teaching science and the parents were more interested in helping in the classroom and doing science at home.

Family Math and Family Science nights. Family Math and Family Science activities are designed to provide a fun, friendly, and relaxed atmosphere for doing mathematics and science. The goal is for parents to develop an understanding of what their children are learning in school and to become more confident in their mathematics and science abilities (Fruchter, Galletta, & White, 1992). The Family Math program was developed by EQUALS, at the Lawrence Hall of Science, University of California, Berkeley. Family Science is an outgrowth of the Family Math program and was developed by Northwest EQUALS at Portland State University. The program was funded with a grant from Chevron, U.S.A. and major partners were the National Urban Coalition and the original EQUALS program at Berkeley.

The activities at Family Math and Family Science nights are enjoyable and emphasize understanding and problem solving instead of rote learning (Kreinberg, 1989). Parents and children use materials and models, solve problems, gather and interpret data, and communicate about mathematics and science. Parents are encouraged to serve as instructors, and thus as models for their children and other parents. Handouts with instructions and other suggestions encourage parents to extend activities at home.

As families work, instructors explain how the activities are tied to the school's curriculum and state standards. At Sears Elementary School in Kenai, Alaska, the Family Science and Math sessions are focused around the school's integrated curriculum. Yolanda Schrader, the school's Title 1 Coordinator, explains, "Many of the activities we present at Family Math and Science have to do with the subjects that the children are studying in their classrooms, for example, night and day, planets, habitat, mag-

Family Math and Science in Kenai, Alaska

For the past nine years, parents and children have been coming to Mountain View Elementary School to learn mathematics and science together. The school presents four or five events every year, with as many as 300 people in attendance. Debbie White, the school's Title 1 Coordinator, started the program in October 1989 with a Family Math night. The events now incorporate science, geography, and technology as well.

The activities are tied to what students are studying in class, but they are also fun and simple enough to do at home. Families build towers with paper clips and paper, play card games using addition and subtraction, or make balloon rockets. The activities are sometimes linked to a common theme, such as air pressure or the human body. Activity packets are available at each event that explain how to do the activities at home and what materials are needed.

People from the community also get involved in the events. A representative from the Department of Fish and Game brought examples of salmon at different stages of development, as well as a full-grown salmon that had been dissected. A member of the Alaska Forestry Division taught families about how trees grow and brought in a section from a large tree so that everyone could count the rings.

Food is an important part of each event and helps draw families. A local restaurant provides pizzas at a significant discount and the school furnishes cookies and lemonade. White also attributes the success of the program to word-of-mouth. "These events are a fun, low-cost evening for the whole family. Families are able to spend time together and visit with other parents and kids as well."

The school uses feedback and suggestions from parents to help plan future activities. For example, many of the parents said they would like to see students lead the activities. This year, a group of students presented an activity using batteries based on what they were learning in class.

The school's computer lab is available for families to use during the events. Parents can explore the Internet with their children. Students also share their portfolios and computer projects that they have created.

"One of the most important benefits is that parents feel comfortable in our school," says Debbie White. "They get to know the staff and other parents from the community. It makes school a less intimidating place for parents."

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Planning mathematics and science events

Some of the essentials for successful events include:

Food—Schools can ask community businesses to help provide food. Pot luck refreshments can be equally successful.

Transportation—Schools can help parents and boost attendance by setting up car pools, using school vans, or asking parent volunteers to pick up families who need a ride.

Scheduling—Plan events for different times, some during the day, some in the evening. Events on weekends allow parents who work during the week to attend.

Planning—Parents should be included in planning all events. They will be able to communicate the needs and desires of the community.

Contacting parents—Send multiple invitations in more than one format. Make sure events are publicized in all available media. One strategy that can make a difference is calling parents directly to invite them; parent volunteers can help. At Sears Elementary School in Kenai, Alaska, events are advertised in the newspaper, students send out postcard invitations to their parents, and each teacher writes about the event in the class's weekly newsletter. The students themselves are one of the most important sources of publicity. "The children are excited about what will be presented at the event. They have prior knowledge and can explain the activities to their parents," says Yolanda Schrader.

Convenient locations—Activities can take place in a variety of locations: community centers, churches, public libraries, shopping centers, and workplaces. Parents who do not live in the immediate neighborhood of the school may have easier access to these other locations. Parents may feel more comfortable on their own turf.

nets, weather, and the ocean. We also incorporate all the elements of math that we can, such as number sense, operations, probability, and estimating."

Family Math and Science have been used primarily at elementary schools, but these events can also be effective for middle schools. At Clear Creek Middle School in Gresham, Oregon, teachers Donna Ball, Linda Randall, and Marsha Mahon presented a Family Math night for incoming sixth-grade students and their families. Parents and students participated in activities, including measuring, spatial visualization, and geometry. There was also a station devoted to examples of state benchmarks and scoring guides.

One way to address the interests of students at the middle school level is to use activities that tie mathematics and science to careers and everyday life (Bobango & Milgram, 1993). For example, instructors can ask family teams to identify the mathematics and science skills used in a wide variety of occupations. Parents may be intimidated by the curriculum at the middle school level. Teachers might consider asking parents what areas are most unfamiliar and then design activities or discussions to help build additional understanding in those areas (Stenmark, Thompson, & Cossey, 1986).

A Family Science night can involve several activities with a common theme. For example, on Astronomy Night families could use a telescope to view the night sky and make observations. Parents who are interested in astronomy can be helpful in planning and providing or obtaining resources. At activity centers in the school, parents and students view slides or a video, draw maps of the sky, and listen to parent- or teacher-led talks about mythology and the stars

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(Cañizo, 1995). This type of activity can be problematic in the Northwest, with its overcast skies and starless nights. In case of bad weather, teachers can supplement with other activities such as making star charts to use at home, a discussion about the history of the telescope and how it works, create-your-own constellation and myth, and additional slides and videos.

Fairs and expos. Science fairs have typically been high stakes competitions for only the top students. Changing the focus into a schoolwide, noncompetitive celebration will draw more parents and will reinforce the idea that mathematics and science are for everyone. Schools do not necessarily need to eliminate the typical science fair competition, but instead combine it with other elements, such as displays of student work, student and class demonstrations, and presentations by community members and parents (Silver, 1994).

Math and science activities and games for families can also be incorporated into a science fair event. Teachers or parents can lead hands-on activities. Students might enjoy teaming up to present one of their favorite classroom activities for parents and other students. Teachers can give an overview of the curriculum and demonstrate lessons (Wolfe, 1994).

Mathematics and science expos require planning and collaboration. It may be helpful for several schools—or perhaps the whole district—to combine their efforts. There are many roles for parents to play, including planning and publicizing the event, securing resources and donations, conducting activities, or making presentations about how they use mathematics or science in their job. Some schools display home projects that students and parents have completed together and schedule times for the teams to demonstrate and debrief their projects (Pearlman & Pericak-Spector, 1993).

It is also possible to highlight mathematics and science at traditional school functions. For example, teachers can transform the annual carnival into a mathematics or science event (Cooper, 1997). Teachers and students demonstrate the mathematics and science behind traditional carnival games, such as friction and the coin toss or probability and a card game. Students can also design their own games based on what they have learned in class.

Another event that engages families is a museum produced by students and modeled on a natural history, science, or technology museum (Monhardt & Monhardt, 1997). Students plan their own interactive exhibits around themes like animals, rocks and minerals, kitchen chemistry, or multicultural mathematics and science. The students are assigned different roles and duties based on their interests, including developing publicity, creating guidebooks, leading tours, or managing the museum shop.

Professional development

Because family involvement is seldom included in teacher education programs, professional development focused on working with families is a key component in the partnership process. The most effective experiences provide teachers with active learning opportunities and include parents in the process.

It is possible that local experts in family involvement will be the best resources. Schools can identify a teacher from the school, district, or community who has outstanding relationships with parents. This teacher and a parent can make a presentation or facilitate an extended training to share ideas and strategies. Local teachers provide knowledge of the community and present approaches that are tailored to the needs of the schools.

Teachers can develop an action research project on family involvement. Parents should participate both as sources of information and as researchers. A related approach could be forming a school or district committee to investigate family involvement. The group evaluates current efforts; assesses the needs of teachers and parents; develops action items; and plans activities, events, and communication methods.

Teachers may want to form a support group to collaborate on parent projects, discuss family involvement issues, and share ideas with each other. Parents can make presentations at staff meetings or teach workshops that help alter preconceptions teachers may have about parents and provide ideas of how to work more effectively with parents (Rioux & Berla, 1993).

Conclusion

The rhetoric of family involvement is pervasive, but examples of true partnership with parents are much more difficult to find. The stories and strategies in this publication are intended to help educators move beyond the rhetoric and take action. There is not a single approach that will improve family involvement and not all of the strategies will work for all schools. The examples were chosen to demonstrate the possibilities of family involvement—providing places to begin as well as ideas to improve existing programs and efforts. The following pages feature a number of resources that educators may find helpful in working with families and engaging them in mathematics and science education.

Resources & Bibliography

Note: All books in this section are available through NWREL's Mathematics and Science Education Center lending library. Contact the Resource Specialist at (503) 275-9499 or math_and_science@nwrel.org to learn how to access these resources.

An asterisk (✻) indicates resources that parents may find useful.

Resources for further reading

✻ Apelman, M., & King, J. (1993). *Exploring everyday math: Ideas for students, teachers, and parents.* Portsmouth, NH: Heinemann.

This book encourages parents to use the many opportunities for mathematical learning in their daily lives. The activities can be done at home or at school. A chart coordinates activities with K-6 curriculum.

Epstein, J.L., & Salinas, K.C. (1992). *Manual for teachers: Teachers involve parents in schoolwork (TIPS). Math and science interactive homework in the elementary grades.* Baltimore, MD: Center on Families, Communities, Schools, and Children's Learning, Johns Hopkins University.

Epstein, J.L., Salinas, K.C., & Jackson, V.E. (1995). *TIPS: Teachers involve parents in schoolwork. Language arts and science/health: Interactive homework in the middle grades. Manual for teachers* (Rev. ed.). Baltimore, MD: Johns Hopkins University, Center on Families, Communities, Schools, and Children's Learning.

These manuals describe ways to develop and implement a TIPS interactive homework project. Sample activities are included as well as information on other types of parent involvement.

Fredericks, A.D. (1993). *Letters to parents in science.* Glenview, IL: Good Year Books.

Teachers can use the reproducible parent letters in this book to suggest activities that develop children's science literacy and appreciation. Grades three through six.

✻ Kanter, P. (1994). *Helping your child learn math.* Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.

This book suggests ways that parents can generate interest in mathematics in children aged five through 13. Twenty-six activities are presented that incorporate games, problem solving, and hands-on experiences to teach mathematical concepts.

Merttens, R., & Vass, J. (Eds.). (1993). *Partnerships in maths: Parents and schools. The impact project.* London, England & Washington, DC: Falmer Press.

In this collection of essays, teachers and parents write about the IMPACT Project in Britain, a program of shared mathematics tasks in the home.

✻ Mokros, J. (1996). *Beyond facts and flashcards: Exploring math with your kids.* Portsmouth, NH: Heinemann.

Parents learn to uncover the mathematics in their daily lives and how to participate with their children in mathematics learning. The book also chronicles a typical math activities for families. Elementary level.

✻ National Research Council. (1998). *Every child a scientist: Achieving scientific literacy for all.* Washington, DC: Author.

This booklet provides guidance to parents and others who want to take an active role in improving the science program in their schools. It explains why high-quality science education is important for all people, and shows how to evaluate school science programs.

National Urban League. (1994). *Parents as leaders in science and mathematics education reform.* New York, NY: Author.

The three videos and the written materials in this planning kit help schools organize parent and community workshops to promote math and science education. Special attention is given to parents who believe that they "aren't good" in math and science.

✻ Northwest Regional Educational Laboratory. (1997). *How do you spell parallel? Visiting middle school math* [Video]. Portland, OR: Author.

This video introduces parents and others to the ongoing changes in mathematics education. Viewers have an opportunity to learn how current approaches improve teaching and learning. The video features footage of three Northwest classrooms.

✻ Paulu, N., & Martin, M. (1991). *Helping your child learn science.* Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.

This book suggests ways that parents can generate interest in science in children aged three through 10. Simple activities are provided that parents can do with their children.

Russell, R. (1996). *Science and mathematics education reform: What do parents need to know to get involved?* Washington, DC: American Association for the Advancement of Science.

This booklet includes recommendations for involving parents in science education such as informing parents of the importance of science and mathematics, and introducing science activities they can do at home with their children.

✻ Sprung, B., Colón, L., Froschl, M., & Jenoure, S. (1990). *Playtime is science: Implementing a parent/child activity program.* New York, NY: Educational Equity Concepts.

The hands-on activities in this program are designed for parents and children to do together. The activities show that parents know more science than they think and can play an important role in getting children excited about science. Ages four through eight.

Stenmark, J.K., Thompson, N., & Cossey, R. (1986). *Family math.* Berkeley, CA: University of Californian, Lawrence Hall of Science.

This book introduces parents and their children to ideas that help improve skills and appreciation for mathematics. The activities develop problem-solving skills and an understanding of mathematics through a hands-on approach. Also includes tips on how to organize and facilitate Family Math events.

Swap, S.M. (1993). *Developing home-school partnerships: From concepts to practice.* New York, NY: Teachers College Press.

This book provides practical suggestions for educators working toward strengthening their relationships with parents. The author examines the benefits of and barriers to parent involvement, then outlines three models of home-school interaction, and concludes with a discussion of proven paths to partnership.

Wikelund, K.R. (1990). *Schools and communities together: A guide to parent involvement.* Portland, OR: Northwest Regional Educational Laboratory.

This guide discusses types of involvement and the benefits and barriers to effective parent involvement, describing the ingredients that are essential to any successful collaboration. Suggestions are included for how to implement effective parent involvement programs.

Organizations

Alliance for Parental Involvement in Education (AllPIE)
PO Box 59
East Chatham, NY 12060-0059
(518) 392-6900
http://www.croton.com/allpie/

AllPIE is a nonprofit organization that assists and encourages parental involvement, both in school and at home. Resources available include a newsletter, conferences, forums, and a lending library.

Center on School, Family, and Community Partnerships
Johns Hopkins University
3505 N. Charles Street
Baltimore, MD 21218
(310) 516-8800
Fax: (401) 516-8890
http://scov.csos.jhu.edu/p2000/center.htm

The mission of the center is to encourage practices that help families and educators work together. The National Network of Partnership Schools guides school teams in improving partnerships.

Increasing Family Involvement in Math and Science Institute
Science and Mathematics Consortium for Northwest Schools (SMCNWS)
171 N.E. 102nd
Portland, OR 97220-4196
(503) 760-2346
http://www.col-ed.org/smcnws/recent.html

This summer institute for teachers and parents is designed to provide tools to increase the involvement of families in mathematics and science education.

National Association for the Education of Young Children
1509 16th Street, N.W.
Washington, DC 20036-1426
(202) 232-8777
(800) 424-1426
http://www.naeyc.org/

This organization provides resources and information for parents who want to ensure their children receive the best possible care and education.

National Coalition for Parent Involvement in Education (NCPIE)
1201 16th Street N.W., Box 39
Washington, DC 20036
(202) 822-8405
Fax: (202) 872-4050
http://www.ncpie.org/start.shtml

NCPIE helps develop effective family/school partnerships throughout America. The coalition offers guidelines for schools, resources, and conferences.

National Parent Information Network (NPIN)
ERIC Clearinghouse on Elementary and Early Childhood Education
University of Illinois at Urbana-Champaign
Children's Research Center
51 Gerty Drive
Champaign, IL 61820-7469
(217) 333-1386
Fax: (217) 333-3767
http://npin.org/

NPIN provides information to parents and fosters the exchange of parenting materials. Free publications, brochures, and other materials are available.

National Parent Teacher Association
330 N. Wabash Avenue, Suite 2100
Chicago, IL 60611
(312) 670-6782
http://www.pta.org/index.stm

The National PTA assists parents in developing the skills they need and encourages parent and public involvement in schools. Current information, programs, and projects encourage parents to participate in education.

Northwest Regional Educational Laboratory (NWREL)
101 S.W. Main, Suite 500
Portland, OR 97204-2397
(503) 275-9500
http://www.nwrel.org/

Child and Family Program
(503) 275-9581
http://www.nwrel.org/cfc

The Child and Family Program assists Northwest schools and programs to develop a holistic approach to address the needs of children at risk, emphasizing child and family strengths.

Equity Center
Joyce Harris, Director
(503) 275-9603
harrisj@nwrel.org
http://www.nwrel.org/cnorse

The Equity Center offers two-day Playtime is Science workshops free of charge for schools in its service area (Alaska, Idaho, Oregon, and Washington). Although the program targets elementary schools, it can be adapted for middle schools. It also has been proven to be beneficial to language minority students and students with special needs.

Mathematics and Science Education Center
Kit Peixotto, Director
(503) 275-0651
peixottk@nwrel.org
http://www.nwrel.org/msec

The center provides resources and services in support of effective curriculum, instruction, and assessment. A lending library of books and other materials is available for all educators and parents in the Northwest states of Alaska, Idaho, Montana, Oregon, and Washington.

Parents for Public Schools
PO Box 12807
Jackson, MS 39236-2807
(601) 982-1222
http://www.pps.net/

A national organization of grassroots chapters dedicated to recruiting students, involving parents, and improving public schools.

School Development Program
Yale Child Study Center
47 College Street, Suite 212
New Haven, CT 06520
(203) 737-1020
Fax: (203) 737-1023
http://info.med.yale.edu/comer/

This systemic school reform strategy was established by James P. Comer, M.D., in 1968. The program mobilizes the entire community of adult caretakers—teachers, administrators, counselors, nonteaching staff, parents, and community members—to support students' development and to effect academic success.

An asterisk (✻) indicates resources that parents may find useful.

Online resources

✻ B.J. Pinchbeck's Homework Helper
http://tristate.pgh.net/~pinch13/

This is a guide to encyclopedias, dictionaries, reference works, and other online resources.

✻ Colorado Parent Information and Resource Center
http://www.cpirc.org/

This site provides parents and teachers with information and resources to help them work together. Tips, suggestions, and links to other resources are provided.

✻ Eric's Treasure Troves of Science
http://www.astro.virginia.edu/~eww6n/TreasureTroves.html

This is an award-winning compilation of mathematics and science information.

✻ Family Education Network
http://familyeducation.com/

This site provides information on everything from after school activities to education trends, news, and policy.

✻ Family Math
http://theory.lcs.mit.edu/~emjordan/famMath.html

The Web site gives an overview of the program, articles from the Family Math newsletter, and links to other sites.

✻ KidSource Online™
http://www.kidsource.com/

This site includes information on education, forums, a mailing list, a guide to software, and links to other Web sites.

✻ Links to Learning
http://www.northeast.isd.tenet.edu/northern/Links.html

This site provides links to Web sites with information and ideas for students and parents.

✻ National Parent Information Network
http://npin.org

This site features articles on parenting, listservs, and links to more than 100 sites.

Partnership for Family Involvement
http://www.ed.gov/PFIE/index.html

This organization helps develop family-school-community partnerships. The Web site features resources, case studies, and links to other programs.

Pathways to School Improvement—Parent and Family Involvement
http://www.ncrel.org/sdrs/

The North Central Regional Educational Laboratory's Web site provides summaries of best practices, research, and lists of materials.

*** SciEd: Science and Mathematics Education Resources**
http://www-hpcc.astro.washington.edu/scied/science.html

An index of Web sites arranged by topic, this site provides links to a wide variety of science-related sites.

*** Science in the Home**
http://red.www.nsf.gov/EHR/EHR/scihome.html

This National Science Foundation site includes links to activities and experiments families can do at home.

*** Steve Savitzky's Interesting Places**
http://www.starport.com/places/

This award-winning site has many unusual links for kids and parents.

Strong Families, Strong Schools
http://eric-web.tc.columbia.edu/families/strong/

Based on the publication of the same name, this site provides a review of research, real-life examples, and concrete strategies.

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Appendices

Appendix A

In mathematics, students' classroom experiences should provide...

Increased attention on:

Problem Solving

- Pursuing open-ended problems and extended problem-solving projects
- Investigating and formulating their own questions from problem situations

Communication

- Discussing, writing, reading, and listening to mathematical ideas

Reasoning

- Validating their own thinking
- Making and evaluating conjectures and arguments

Connections

- Connecting and applying mathematics to other subjects and to the real world
- Connecting topics within mathematics

Number/Operations/Computation

- Creating algorithms and procedures
- Using estimation both in solving problems and in checking for reasonableness
- Developing an understanding of ratio, proportion, and percents

Decreased attention on:

Problem Solving

- Practicing only routine, one-step problems

Communication

- Responding to simple questions that can be answered with yes, no, or a number

Reasoning

- Relying on outside authority before checking for reasonableness

Connections

- Learning isolated topics
- Developing skills out of context

Number/Operations/Computation

- Memorizing a formula or procedure without understanding
- Practicing tedious paper-and-pencil computations

(National Council of Teachers of Mathematics, 1989)

Appendix B

In science, students' classroom experiences should provide...

Increased attention on:

- Understanding scientific concepts and developing abilities of inquiry
- Integrating all aspects of science content
- Studying a few fundamental science concepts
- Activities that investigate and analyze science questions
- Extended investigations
- Process skills in context
- Using evidence to develop or revise an explanation
- Doing more investigations in order to develop understanding, ability, and knowledge of science content
- Applying the results of experiments to scientific arguments and explanations
- Students communicating their ideas and work to classmates

Decreased attention on:

- Knowing scientific facts and information without understanding
- Separating science knowledge and science process
- Covering many science topics superficially
- Activities that only demonstrate and verify science facts
- Investigations confined to one class period
- Process skills out of context
- Revising evidence in favor of expected responses
- Doing few investigations in order to leave time to cover large amounts of content
- Concluding experiments by stating the results without understanding how they apply
- Students communicating their ideas and conclusions to the teacher only

(National Research Council, 1996)

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